

Digitalization: A Game Changer for Local Governments & Communities

Enhancing Capacities to Deploy Transformative Solutions

Policy Brief

November 2023

Executive Summary

Local authorities stand on the brink of a significant transformation, partly driven by harnessing digital tools and processes to enhance their capacities. There is immense potential for digitalization driven and enabled by local governments. It can spur economic growth, transparency, improved governance efficiency, and environmental sustainability. Technologies like the Internet of Things (IoT), Artificial Intelligence (AI), Blockchain, and Digital Twins are at the forefront of this revolution. They offer smart and sustainable urban systems, enhance governance, and facilitate inclusive service delivery. In combination, the transformative impact of digitalization reshapes local governance, bolsters community resilience, and paves the way for sustainable, equitable societies. This policy brief highlights the game-changing power of digitalization and how local governments and communities can harness its full potential.

Despite clear benefits, adopting digitalization is challenging, especially for cities in the Global South, where local governments face increased skills and technology gaps, infrastructure deficits, socio-economic barriers, and governance issues. This digital divide, which is more pronounced in developing regions, hampers the effective deployment of digital solutions.

A multilevel governance approach is essential to realize digitalization's full potential. This approach involves a comprehensive assessment of the current operational state, strategic planning that aligns with regional and national policies, and extensive stakeholder engagement. Essential to this process are capacity building, resource allocation, and collaborative strategies such as public-private partnerships and intergovernmental cooperation. Local governments need to establish stakeholder inclusion strategies, promote innovation and trust in IT infrastructure, and implement systematic monitoring and evaluation to assess the impacts of digital initiatives.

To support the digital transformation of local governments, this policy brief provides several key recommendations. For instance, local governments should establish Digital Transformation Task Forces composed of members from various departments and tech experts. Such task forces are critical for ensuring a comprehensive and continuous approach to digitalization, spanning different administrative periods. The brief also emphasizes the importance of implementing Digital Literacy Programs. These programs

are crucial for equipping government employees and citizens with the necessary skills to use and benefit from digital technologies effectively. Another key recommendation is the development of Digital Inclusion Policies, which ensure that all community members, especially those in marginalized and underrepresented groups, have access to digital technologies. Additionally, the policy brief suggests upgrading key public services with digital technologies and investing in secure digital infrastructure. This includes implementing e-government portals for efficient public service delivery and strengthening cybersecurity measures to protect sensitive data and systems. These recommendations collectively aim to modernize local governance and make it more efficient, inclusive, and responsive to the community's needs in an increasingly digital world.

Climate Academy 2022 - Digitalization, Energy Transition and Climate Action

This policy brief reflects the discussions from the Climate Academy 2022. The Climate Academy aspired to address the challenges associated with climate change through a series of dedicated events jointly organized by the United Nations University Institute for Environment and Human Security (UNU-EHS) and Munich Re Foundation (MRF) in collaboration with the UN Climate Change Secretariat (UNFCCC) and with ICLEI World Secretariat (ICLEI) as a special partner. ICLEI led the digitalization track of the event. The content reflects the discussion initiated during the event that has been further strengthened, restructured, and refined by the technical contribution of ICLEI partners and experts from the ICLEI Urban Research, Innovation, and Development Team. The resulting policy brief, to be launched at COP28, is the result of this collaboration. It stands as a resource for governments to integrate digitalization with their processes holistically and sustainably to derive maximum benefits for people and the planet.



With further contributions from:



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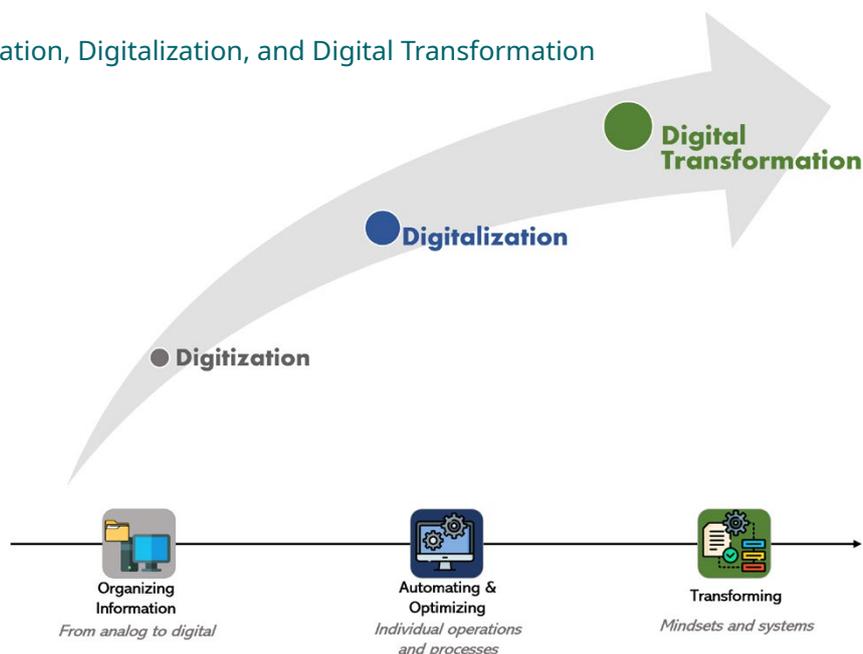


Introduction

In an era where technology continually reshapes our lives, digitalization is pivotal for empowering local governments and communities. Local authorities can significantly enhance their capacities by harnessing digital tools and processes, paving the way for a sustainable transition that aligns with modern demands and ecological imperatives. To fully comprehend this potential, it is crucial to understand the nuances and interplay of key concepts: Digitization, Digitalization, and Digital Transformation. These terms - often used interchangeably - describe distinct aspects of the digital revolution that are instrumental in driving sustainable change at the local level.

Digitization	Digitalization	Digital transformation
<p>This is the process of converting information from an analog format into a digital one. It started around the 1950s with the invention of the computer. Examples include digitizing manuscripts to preserve knowledge or governments digitizing public services to make them available online. Digitization is essentially about converting physical records, documents, or objects into a digital format. Digitization is the first step towards Digitalization [1].</p>	<p>This goes a step beyond digitization. It involves using digital technologies to change business processes, improve organizational operations, and create new (or modify existing) business and cultural environments. Digitalization transforms activities and processes through digital means, often leading to increased efficiency, accessibility, and new capabilities [1].</p>	<p>This represents a more comprehensive overhaul, encompassing every aspect of an organization, business, city, or even society. It involves integrating digital technology into all areas of an entity, fundamentally changing how it operates and delivers value to customers. This transformation isn't just about digitizing or digitalizing elements but is a more holistic and strategic overhaul, often driven by innovations such as AI and machine learning. Digital transformation reflects a cultural, operational, and structural shift towards a digital-first approach across the entire scope of an entity [2], [3].</p>

Figure 1. Digitization, Digitalization, and Digital Transformation



Each process represents a progressively more integrated and strategic use of digital technologies, moving from merely converting analog to digital through process improvement using digital tools to completely transform the entire system or organization into a digitally-driven entity.

The widespread adoption of digital technologies by numerous companies and businesses is a testament to their immense benefits, leading to an accelerated shift toward digitalization [1]. However, this transition is occurring more rapidly in developed countries, causing digital technologies in the Global South to be associated with inequality [4]. This digital divide could increase exponentially if no action is taken to bring advantageous digital technologies to local governments and communities.

This policy brief emphasizes the significant potential of digitalization, detailing the pathways to achieving it, with a particular emphasis on practical examples from the Global South. It will then delve into the various challenges associated with digitalization, followed by a comprehensive set of policy recommendations designed to address and overcome them.



The Game-Changing Potential of Digitalization

What are the Game-Changing Technologies?

Digitalization is the process of using digital technologies to transform information, processes, and services. It can bring multiple benefits for local governments, such as cost savings, economic growth, social welfare, governance efficiency and transparency, and environmental sustainability. However, to embrace digitalization, local governments must adopt a strategic and holistic approach that considers the vision and leadership, policy and regulatory frameworks, infrastructure and technology, skills and capacities, and collaboration and participation aspects of digitalization. This section of the policy brief highlights the game-changing potential of some of the existing and emerging digital technologies for urban governance and development. It provides some examples and recommendations for local governments to leverage them.

Internet of Things (IoT)

IoT refers to the network of physical objects, such as sensors, devices, and appliances, connected to the Internet and can collect, process, and exchange data [2]. IoT can enable smart and sustainable urban systems, such as smart energy, smart mobility, smart waste, and smart water, that can optimize the use of resources, reduce emissions and waste, and improve the quality of life and well-being of urban residents [2]. There were 15.1 billion IoT devices worldwide in 2020, expected to almost double to 29 billion by 2030 [3]. Local governments can use IoT to monitor and manage various urban parameters, such as traffic, air quality, water quality, and waste generation, and to provide real-time feedback and alerts to citizens and stakeholders. For example, Barcelona has deployed over 500 km of fiber optic network and more than 22,000 sensors to create a smart city platform that integrates data from various sources and provides information and services to citizens, businesses, and public administrations [5].



Artificial Intelligence (AI)

AI refers to the ability of machines and systems to perform tasks that normally require human intelligence, such as reasoning, learning, and decision-making. AI can enable more effective and transparent urban governance and development, such as AI-based planning, AI-based monitoring, AI-based evaluation, and AI-based participation, that can enhance the performance and accountability of urban actors and sectors and increase the engagement and feedback of urban citizens and stakeholders [6]. Global spending on AI is expected to reach \$500 billion by 2027 [7] and could contribute \$13 trillion to the economy by 2030 [8]. Local governments can use AI to analyze large and complex data sets, such as satellite imagery, social media, and urban sensors, and to generate insights and recommendations for urban planning, management, and policy-making. For example, Singapore has developed an AI platform called Virtual Singapore that simulates various scenarios and outcomes for urban development, such as land use, mobility, energy, and environment.

Blockchain

Blockchain refers to a distributed ledger technology that securely, transparently, and decentralized records and verifies transactions and data. Blockchain can enable more efficient and trustworthy urban governance and development, such as blockchain-based identity, blockchain-based voting, blockchain-based contracts, and blockchain-based services, that can reduce the costs and risks of intermediaries, fraud, and corruption and improve the access and empowerment of urban actors and sectors [9]. According to PwC, 84% of the organizations surveyed in 2018 were involved with blockchain somehow, and 54% of the executives surveyed in 2020 expected blockchain to become mainstream by 2025 [10]. Local governments can use blockchain to create and manage digital identities, such as biometric IDs, that can facilitate the delivery and verification of public services, such as health, education, and social security. For example, India has implemented a blockchain-based identity system called Aadhaar that provides a unique 12-digit number to more than 1.2 billion citizens and enables them to access various government and private services [11].

Digital twins

Digital twins are digital models of real-world physical objects, systems, or processes that can simulate, monitor, and optimize their performance and behavior. Digital twins can help local governments improve their urban governance and development by enabling them to test and evaluate different scenarios and outcomes for urban planning, management, and policy-making, using data from various sources and sensors; enhance the efficiency and transparency of urban services and processes, such as energy, mobility, waste, and water, by using data analytics and machine learning; reduce the costs and risks of intermediaries, fraud, and corruption, by using blockchain technology to record and verify transactions and data in a secure, transparent, and decentralized way; and engage and involve citizens and stakeholders in the design and implementation of urban initiatives, by using digital platforms and tools to facilitate communication, participation, and feedback [12]. Digital twins can generate value for local governments in three ways: by increasing revenues, by reducing costs, and by improving quality [12]. Their market investment value is estimated to reach 48 billion by 2026 [12]. Some examples of local governments adopting digital twins are Singapore [13], the United States, and New Zealand [9].

On an EU level, the European Commission has recognized the relevance of Local Digital Twins as enablers for the next phase of smart and sustainable cities and communities. For this, it would be necessary to highlight the relevance of the data foundation part (availability, quality, and interoperability) and the technical foundation component (IoT, cloud computing, big data, AI, 5G) for the successful development of Digital Twins. The Commission is funding an EU Local Digital Twin toolbox, composed of open standard solutions, reference architecture, and re-usable tools, through the EU DIGITAL program.¹

1 <https://digital-strategy.ec.europa.eu/en/library/local-digital-twins-forging-cities-tomorrow>

These are examples of digital technologies with a game-changing potential for urban governance and development. They can help local governments create more sustainable, resilient, and inclusive urban and regional systems and contribute to the global efforts to combat climate change and achieve the Sustainable Development Goals. However, to harness the full potential of these technologies, local governments need to overcome the challenges and barriers that may hinder their adoption and implementation, such as lack of awareness, skills, resources, infrastructure, regulation, and collaboration. Therefore, local governments must adopt a strategic and holistic approach to digitalization that considers the vision and leadership, policy and regulatory frameworks, infrastructure and technology, skills and capacities, and collaboration and participation aspects of digitalization. By doing so, local governments can unlock the numerous possibilities and opportunities that digitalization offers for their development and well-being.

All these technologies, plus several more, shape the digital ecosystem. They can be implemented separately or in tandem to create synergies and gain more benefits (Fig. 2).



Figure 2. The Digital Ecosystem

Why are they Game-Changing for Local Governments?

In today's rapidly evolving technological landscape, digitalization is a pivotal force reshaping the functionalities of local governments and catalyzing community transitions towards sustainable futures. This section of the policy brief underscores the transformative impact of digitalization, describing how it can revolutionize local governance, fortify community resilience, and streamline the path toward a sustainable and equitable society.

All steps of the digital transformation can be highly rewarding. Simply digitizing certain information can cut 90% of a company's expenditure [14]. Beyond the benefits for companies, digitalizing can also



improve service delivery and processes for local, regional, and national governments. Countries more advanced in digitalization gain 20% more economic benefits than those just starting digitalization [14]. It can also decrease unemployment, improve citizens' quality of life, and give people a wider range of public services [14].

Enhancing Government Efficiency

Digitalization offers an unparalleled opportunity for local governments to augment their operational efficiency [14]. By digitizing records and implementing electronic governance (e-governance) platforms, municipalities can significantly reduce administrative burdens, increase transparency, and enhance service delivery [2]. The transition to digital platforms facilitates more streamlined processes, reduces paperwork, and provides real-time data access, enabling quicker and more informed decision-making and cultivating trust among citizens [2], [5]. Digitalization also makes employees feel recognized and supported by automating tedious processes and assisting with task organization, helping to bridge the employee-employer hierarchy in governments and other entities [14].

Fostering Economic Development

Local governments can leverage digital tools to stimulate economic growth and innovation within their communities [2]. Digital platforms can support local businesses by providing them access to broader markets, digital marketing tools, and e-commerce capabilities [14]. Furthermore, governments can utilize data analytics to understand economic trends, identify growth opportunities, and tailor economic policies that bolster local economies. By embracing digitalization, local governments can create a conducive environment for start-ups and entrepreneurs, fostering a dynamic, technology-driven economy.

Empowering Communities through Digital Inclusion

Digitalization has the potential to bridge societal divides by ensuring inclusive access to technology. Initiatives like public Wi-Fi zones, digital literacy programs, and accessible online services can democratize technology access. For instance, Germany passed the Online Access Act in 2020, requiring over 500 public services to be digitized so these services, such as healthcare and government support, could be provided online during COVID-19 [15]. Such inclusivity is vital for empowering marginalized and underserved groups, allowing them to participate fully in the digital economy and society. Moreover, digital platforms can facilitate community engagement and participation in local governance, enabling citizens to voice their opinions, access information, and engage with their representatives more effectively.

Advancing Sustainable Urban Development

Digitalization can foster sustainable pathways in all levels of governance, from country to community and among several sectors of the economy. Smart city initiatives, which employ IoT sensors and data analytics, can optimize resource use, improve traffic management, enhance public safety, and monitor environmental parameters. By harnessing these technologies, local governments can improve the quality of life in urban areas and contribute significantly to global environmental goals, such as reducing carbon footprints and promoting sustainable resource utilization [16]. In China alone, digitalization is estimated to reduce CO₂ emissions by 12-22% for society and 10-40% for Chinese industries by 2030 [16].

Catalyzing Sectoral Innovations

The scope of digitalization extends beyond governance and economic development; it has the potential to revolutionize various sectors such as healthcare, education, energy, and transportation [17]. Telemedicine, digital learning platforms, and intelligent transportation systems exemplify how digital technologies can radically improve service delivery and efficiency. Blockchain, for instance, can assist with buying and selling electricity, aid energy companies, and empower consumers to monitor their own consumption and pay remotely [18], [19]. These innovations offer convenience and ensure that critical services are accessible even in remote or underserved areas.

Digitalization is not merely a technological upgrade but a paradigm shift in how local governments operate, interact with citizens, and conceive the future. By embracing digitalization, local authorities can unlock numerous possibilities for enhancing efficiency, promoting economic growth, ensuring inclusivity, and driving sustainable development. As such, digitalization is a cornerstone for local governments aiming to adapt to modern challenges and transition toward thriving, resilient communities. This transformation is a journey that requires strategic planning, stakeholder engagement, and a commitment to continuous innovation and improvement.



Challenges to Deploying Digitalization by Local Governments

The challenges of deploying digitalization by local governments, especially in the Global South, are multifaceted and significant. Although digitalization can transform government operations and services, it presents a set of complex challenges, trade-offs, and hidden costs [20] [21]. This complexity highlights the need for a nuanced and strategic approach to digitalization, acknowledging its transformative potential and its inherent challenges. The main challenges that countries in the Global South face can be categorized into three main areas: skills and technology gaps, infrastructure deficit and socio-economic barriers, and governance and organizational hurdles.

Skills and Technology Gaps

Local governments often grapple with a shortage of human capital equipped with essential technology skills. A slow uptake of technology, inconsistent data, and significant data security challenges exacerbate this gap. Key issues in this category include [22] [23] [24] [25]:

- **Insufficient technology skills among the workforce:** Local governments often face a shortage of personnel proficient in technology, which hinders effective digitalization.
- **Gap in specialized skills for emerging technologies:** There's a lack of expertise in newer, specialized technologies, delaying their adoption and integration.
- **Inadequate technology readiness at the senior management level:** Senior management often lacks the necessary technological knowledge, impacting strategic decision-making.
- **Poor integration between various technological systems:** Different technological systems within local governments are often poorly integrated, leading to inefficiencies.

- **Limited access to necessary data:** Governments struggle with accessing the data required to implement effective digital solutions. Cities also often lack the capacity to analyze, process, and obtain meaningful insights from different data sources.
- **Hesitancy in embracing new digital solutions:** There’s a reluctance among local government entities to adopt new digital technologies, thus slowing down the progress.

Infrastructure and Socio-Economic Barriers

Inadequate infrastructure and the high costs of digital technologies create a formidable barrier. The lack of appropriate funding exacerbates these challenges. Additionally, socio-economic issues, such as high-income inequality and widespread poverty, especially in developing countries, significantly hinder the effective deployment of digital solutions. This is commonly referred to as the digital divide (fig. 3).

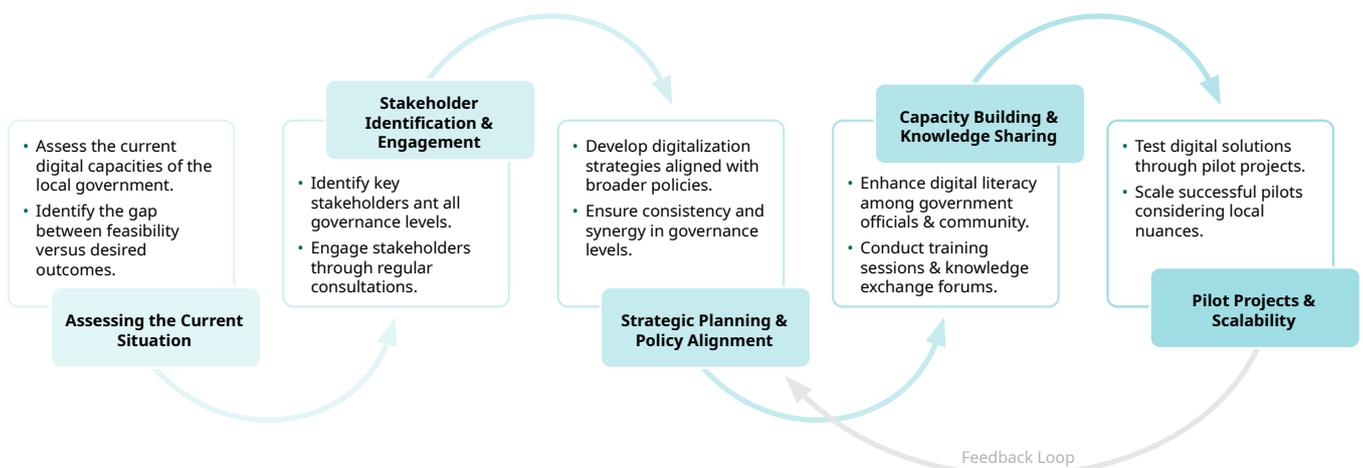


Figure 3. Digitalization Implementation Process

Specific challenges include [20] [26] [25]:

- **Inadequate digital infrastructure:** There’s often a lack of essential digital infrastructure, especially in the Global South. Existing infrastructure may also lack resilience to climate impacts such as extreme heat or flooding and other shocks, including cybersecurity attacks.
- **High costs of digital technology adoption:** The financial burden of adopting digital technologies is a significant barrier for local governments.
- **Insufficient funding for digital initiatives:** Limited funding restricts local governments’ capacity to pursue digitalization.
- **Socio-economic disparities affecting technology access:** High-income inequality and poverty limit digital technologies’ access to and impact.
- **Limited access to basic services affecting digital inclusion:** In areas where basic services are scarce, digital inclusion becomes more challenging.
- **Prevalent poverty impacting technology uptake in Africa:** Widespread poverty in African regions severely limits the adoption of digital technologies.



Governance and Organizational Hurdles

Without a clear digital vision or mission within governments, digitalization can be fragmented. There is also a lack of expertise who can lead digitization initiatives. As a result, organizational structures often fail to integrate digital components effectively. Other challenges in this area include [23] [24] [25]:

- **Lack of a cohesive ICT and digital technology strategy:** Many governments lack a unified strategy for ICT and digitalization, hampering progress.
- **Deficiencies in expertise for driving digitization:** There's a lack of specialized expertise for leading and managing digital initiatives.
- **Organizational structures not conducive to digital transformation:** Existing frameworks often do not support or facilitate digital change.
- **Low prioritization of digital technology projects:** Digital projects are frequently not prioritized, leading to delayed or inadequate implementation.
- **Disruptions and lack of continuity due to administrative changes:** Frequent administrative shifts can disrupt and hinder digitalization efforts.
- **Lengthy supply chain processes for digital technologies:** Complicated and extended supply chain processes delay the acquisition and implementation of digital technologies.
- **Resistance to digital change among citizens:** There's often resistance to digital transformation among the population, impacting acceptance rates.

Addressing these challenges requires a coordinated, whole-of-government approach involving various actors across multiple levels of government, non-governmental stakeholders, and international partners. This next section discusses the process of achieving digitalization and overcoming these challenges.



Achieving Digitalization Through Multilevel Governance

Multilevel governance is vital for leveraging digitalization to empower local governments and drive sustainable community transitions. It necessitates a coordinated approach among different government levels, involving collaboration with the private sector, academia, and civil society. Key to this process is the development of policies that facilitate digital integration, backed by the necessary resources, including financial, technical, and infrastructural support. Collaborative strategies will focus on sharing knowledge, co-creating solutions, and harnessing digital tools for innovative and sustainable community development. This approach aims to establish a unified digital ecosystem that enhances public services and promotes inclusive growth at the community level. This section outlines the process, resources, and collaborative strategies necessary to realize this vision.



Implementation Process

1. Assessing the Current Situation

The first step of digital transformation is to assess the current situation of the local government, in terms of its strengths, weaknesses, opportunities, and threats. This can be done by identifying existing capacities and resources and aligning them with the vision of digital transformation, which helps to identify the gap between feasibility versus desired outcomes that affect the digitalization journey and determine the amount of time and resources required to achieve it [19], [20].

2. Stakeholder Identification and Engagement

Identifying key stakeholders across various levels of governance, including local, regional, and national authorities, alongside private sector players and community representatives, is crucial. Engaging these stakeholders through regular consultations and collaborative platforms ensures the incorporation of diverse perspectives and expertise.

3. Strategic Planning and Policy Alignment

Developing a comprehensive digitalization strategy aligned with broader regional and national policies is vital. This ensures consistency and synergy across different governance levels, maximizing the impact of digital initiatives.

4. Capacity Building and Knowledge Sharing

Enhancing local government officials' and community members' digital literacy and skills is a foundational step. Regular training sessions, workshops, and knowledge exchange forums can facilitate this capacity building.

5. Pilot Projects and Scalability

Initiating pilot projects allows for testing digital solutions in a controlled environment. Successful pilots can then be scaled to wider areas, considering local nuances and requirements.

6. Feedback Loops

Establishing feedback loops is a crucial step for ensuring the effectiveness and sustainability of digital transformation. Feedback loops allow for collecting and analyzing data and information on the performance and impact of digital solutions, and for learning from the results and adjusting the solutions accordingly. Feedback loops also allow for engaging and empowering the stakeholders and beneficiaries of digital transformation, and for incorporating their feedback and satisfaction into the improvement of digital solutions.

Resource Allocation

1. Financial Resources

Effective resource allocation is vital for digitalization initiatives in local governments. This involves establishing secure and sustainable funding mechanisms, combining government funding, private investments, and international grants. Adhering to the 'finance follows function' principle ensures that funds align with specific digitalization goals. Fiscal decentralization enables the efficient transfer and management of resources [27]. Transparent and accountable handling of these funds is essential for maintaining trust and ensuring the effectiveness of digital projects.

2. Technological Infrastructure

Investment in robust, resilient, and accessible technological infrastructure, including broadband connectivity and digital platforms, is fundamental. This ensures that digital solutions are equitable and reach the wider community.

3. Human Capital

Investing in human capital through training and hiring skilled personnel is crucial for effectively implementing and maintaining digital solutions. Enhancing digital capabilities across all governance levels is of utmost importance. The evolving digital landscape demands a continuous upskilling of civil servants [28]. Governments should offer innovative, flexible training opportunities to build the necessary skills and competencies for digital governance.

Collaborative Strategies

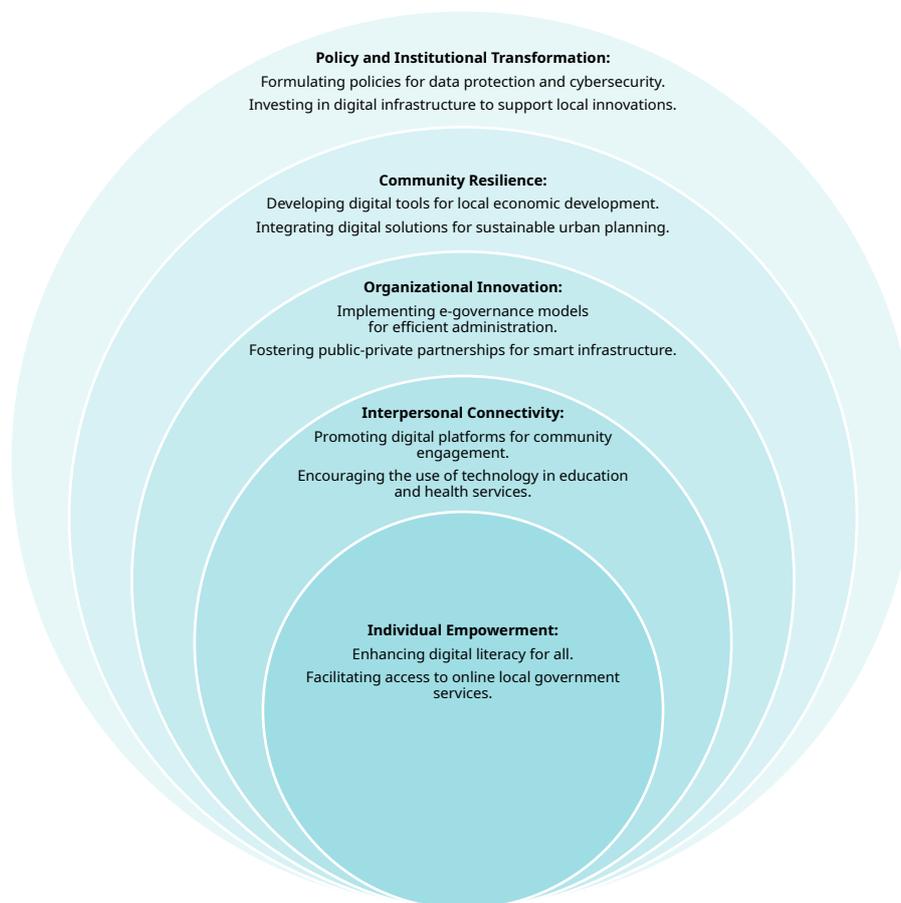


Figure 4. Digitalization Framework for Local Governments & Communities

Figure 4 depicts a multi-level approach to digitalization within local governments and communities. It begins with “Individual Empowerment” at its core, advocating for digital literacy, and expands outwards through layers of “Interpersonal Connectivity,” “Organizational Innovation,” “Community Resilience,” to the “Policy and Institutional Transformation.” Each layer represents a strategic focus area, from personal access to policy enactment, necessary for comprehensive digital integration. It represents a visual depiction of the multifaceted approach required to achieve digitalization through multilevel governance and mirrors the comprehensive strategies outlined in further detail in the text below.



1. Public-Private Partnerships (PPPs)

Encouraging PPPs can leverage the strengths and resources of the private sector, bringing in innovation and efficiency.

2. Intergovernmental Cooperation

Strengthening cooperation between different levels of government ensures a cohesive approach to digitalization, avoiding duplication of efforts and resources.

3. Community Involvement

Actively involving community members in designing and implementing digital initiatives ensures that these solutions are tailored to their needs and challenges.

4. Establishing Adoption Strategies for Stakeholders

Effective adoption of digital initiatives requires strategically phased interventions. Empirical evidence suggests that informative and social influence nudges significantly increase public uptake of online services [29]. Adoption strategies could include creating accessible documentation in local languages, setting up help desks, and establishing flexible business engagement models to encourage diverse market participation. Additionally, incentivizing using digital channels and conducting capacity-building camps can ensure widespread adoption.

5. Promoting Agenda-Setting Innovation and Trust in IT Infrastructure

Local governments should encourage innovation in their IT systems by engaging local businesses to help ensure their technology remains relevant and efficient. Building public trust in e-governance requires transparent communication about IT systems' risks, privacy, and security [29]. Utilizing the Internet and social media platforms for public engagement can enhance transparency and trust in e-government initiatives [30] [31] [32] [33].

6. Implementing Systemic Monitoring and Evaluation (M&E)

A robust M&E framework is essential to assess the impact of digital initiatives [27]. It helps identify policy design and implementation barriers, enabling iterative improvements to enhance digitalization [28]. Regularly monitoring and evaluating digital initiatives helps assess their impact, guide future advancements, and ensure accountability.

Achieving digitalization through multilevel governance requires a concerted and coordinated effort involving various stakeholders. By following a structured process, allocating resources appropriately, and fostering collaboration, local governments can significantly enhance their capacities and lead communities toward a sustainable and digital future.

Roadmap to the Sustainable Implementation of Digital Technologies

The roadmap to sustainable implementation of digital technologies highlights the essential steps necessary to balance technological advancement with environmental responsibility. It involves a comprehensive approach to evaluate the environmental impact of digital tools from their inception to disposal. This includes conducting life cycle analyses, assessing carbon footprints, and establishing sustainability criteria. The strategy prioritizes sustainable and energy-efficient technologies through green procurement policies and software optimization. This roadmap provides a detailed framework for ensuring that the progression towards a digitally enhanced future is environmentally sustainable.

1. Assessing Environmental Impact of Digital Tools Pre-Implementation

- **Life Cycle Analysis:** Before implementing any digital technology, conduct a life cycle analysis to assess its environmental impact from production to disposal.
- **Carbon Footprint Evaluation:** Evaluate the carbon footprint of digital tools, including the energy consumption during operation and the emissions related to their production and disposal according to international standards and frameworks.
- **Sustainability Criteria:** Develop and apply a set of sustainability criteria for selecting digital tools, considering factors like energy efficiency, material use, and recyclability.

2. Prioritizing Sustainable and Energy-Efficient Digital Technologies

- **Green Procurement Policies:** Implement policies prioritizing digital technology procurement with lower environmental impacts.
- **Energy-Efficient Infrastructure:** Invest in energy-efficient servers, data centers, and networking infrastructure.
- **Software Optimization:** Encourage developing software optimized for energy efficiency, reducing the energy consumption of digital operations.

3. Promoting Sustainable Practices in Governments, Businesses, and Communities

- **Government Leadership:** Governments should lead by example by integrating sustainable digital technologies into their operations.
- **Incentives for Businesses:** Incentivize businesses to adopt sustainable digital practices, such as tax breaks or grants.
- **Community Awareness and Education:** Educate the community about the benefits of sustainable digital technologies and promote their adoption at the grassroots level.

4. Supporting Synergies Between Technological Systems

- **Integrated Systems Design:** Encourage the design of digital systems that can easily integrate with other technologies, enhancing overall efficiency.
- **Cross-Sector Collaboration:** Foster collaboration between sectors (like energy, transportation, and IT) to create synergistic solutions combining digital technologies with other sustainable innovations.
- **Standardization and Interoperability:** Develop standards to ensure future interoperability of digital systems, facilitating seamless integration and data exchange between different technologies and platforms.

5. Ensuring Future Interoperability

- **Forward-Looking Standards:** Develop and adopt forward-looking standards, considering future technological advancements to ensure long-term interoperability.
- **Modular and Scalable Designs:** Promote the design of digital systems that are modular and scalable, allowing them to evolve with changing technologies and needs.
- **Continuous Adaptation:** Regularly update policies and standards to adapt to new technological developments, ensuring that sustainable digital technologies remain compatible and efficient in the long term.

In the following sections, we will present real-world examples demonstrating the successful implementation of these strategies, showcasing the tangible benefits and impacts of digitalization across various sectors and communities.

Examples of Digitalization

Local Engagement (Knowledge Sharing)

TITLE: Illustrated Natural Asset Maps

LOCATION: Kochi, India; population - 0.667 million in 2011 [30], 0.829 million in 2023 [31].

CONTRIBUTORS: ICLEI and INTERACT-BIO

BENEFICIARIES: Kochi City

CHALLENGE: Amid a biodiversity crisis, Kochi's large, internationally recognized wetland, backwater canals, and mangroves are even more critical to protect [30]. Yet, like most cities, continued urbanization has polluted the water and air, reduced habitat, and displaced species [30].

RESPONSE: This project maps Kochi's biodiversity and ecosystems to increase awareness and inform further infrastructure plans and policies [30]. The natural asset mapping features local and traditional knowledge to produce visually stimulating outputs and enhance citizens' local environmental accountability [30].

OUTCOME: These digitalized maps support local governments' integration of ecosystem management and conservation into urban planning. It also promotes community involvement for sustainable development. The map has proved useful for officials who seek a more accessible way to interpret and communicate data [30].

KEY LEARNINGS: Illustrated Natural Asset Maps are uniquely powerful digital tools that simplify, represent, and communicate information about complex ecosystem structures, functions, and services in a geographic area [30].

The Kochi Illustrated Natural Asset Maps project offers several key learnings for other local governments:

- **Integrating Traditional Knowledge with Modern Technology:** The project demonstrates the value of combining local and traditional knowledge with digital technology. This integration can produce tools that are not only informative but also culturally relevant and engaging to the local community.
- **Enhancing Environmental Awareness and Accountability:** By mapping biodiversity and ecosystems, local governments can significantly increase public awareness about the importance of these natural assets. This awareness, in turn, fosters a sense of environmental accountability among citizens.
- **Data Visualization for Better Decision-Making:** The digitalized maps are a powerful tool for officials, providing an accessible way to interpret complex environmental data. This visual approach can aid in more informed urban planning and ecosystem management decisions. It also increases awareness among the public, fostering a sense of environmental accountability.
- **Promoting Community Involvement:** The project underscores the importance of involving the community in sustainable development initiatives. When citizens are engaged and informed, they are more likely to support and participate in conservation efforts.
- **Balancing Urbanization with Environmental Conservation:** Kochi's experience highlights the challenges of urbanization, such as pollution and habitat loss. The project shows how local governments can proactively address these issues by incorporating ecosystem conservation and digital technologies into urban planning processes. This initiative serves as a model for other cities facing biodiversity crises.

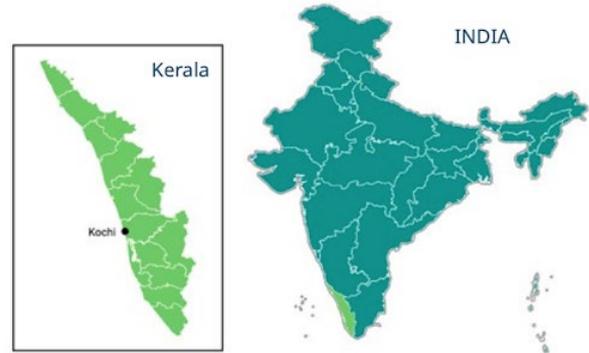


Figure 5. Kochi City in Kerala, India [30]



Energy

TITLE: Enel Installs Smart Meters In São Paulo

LOCATION: São Paulo, Brazil, 19,459,561 people [32].

CONTRIBUTOR: Enel and the Brazilian Electricity Regulatory Agency

BENEFICIARIES: Citizens and industries of São Paulo

CHALLENGE: Electrical bills can be a huge, unexpected cost for families, as most electricity systems do not provide a way to manage energy use.

RESPONSE: Enel installed 300,000 smart meter devices free of charge to consumers in São Paulo [34]. Smart meters are small, user-friendly digital devices that display and record data for household electrical grids, such as energy consumption, current, and voltage levels. Smart meters allow consumers to keep track of their energy consumption, optimize energy use, and help pinpoint energy-intensive or faulty appliances [34], [35]. They also automatically send consumption information to the electrical company, allowing for a more accurate electricity bill [34]. The accompanying app provides additional information to users, including any changes to their bill, and it can alert them if they are approaching their personalized energy consumption level, helping customers stay under budget [34].

KEY LEARNINGS: This example shows that digitalizing energy grids can benefit electrical companies and consumers. In low-income areas, these small devices can make electricity more affordable to families.

The example of Enel installing smart meters in São Paulo, Brazil, offers several key learnings for other local governments considering similar energy management initiatives:

- **Enhanced Consumer Awareness and Control:** Smart meters complemented by user-friendly apps empower consumers with real-time data on their energy usage. This visibility allows households and industries to monitor and manage their consumption more effectively, leading to potential cost savings. This can also significantly reduce billing disputes and enhance customer trust in utility services.
- **Promoting Sustainable Energy Practices:** The project demonstrates how technology can be leveraged to promote sustainability. Smart meters encourage more responsible and environmentally friendly energy use by making energy consumption visible and manageable.
- **Public-Private Collaboration:** The collaboration between Enel, a private company, and the Brazilian Electricity Regulatory Agency highlights the importance of public-private partnerships in implementing large-scale infrastructure projects.
- **Consumer Education and Engagement:** The success of such initiatives also hinges on educating and engaging consumers about the benefits and use of smart meters, ensuring that the technology is adopted and used effectively. Offering smart meters free of charge to consumers can be a significant incentive for widespread adoption, making advanced technology accessible to all socio-economic segments.
- **Scalability and Long-term Vision:** Starting with a sizable but manageable number of installations (like 300,000 in São Paulo) can provide valuable insights and data, allowing for adjustments before scaling up the project.



Figure 6. The City of São Paulo [33]



Digital Finance for Community-Based Initiatives

TITLE: Sun Exchange² funds Micro-grids across Small Villages with Micro Investments

LOCATION: 80+ Projects, mostly across South Africa. See the map for more locations

CONTRIBUTOR: The Sun Exchange and Investors

BENEFICIARIES: Local communities from many countries

CHALLENGE: 1.2 billion people throughout the continent of Africa do not have access to electricity [20]. Energy shortages and rapid population growth have exacerbated energy poverty [20].



Figure 7. Locations of Sun Exchange Projects [36]

RESPONSE: Sun Exchange sets up microgrids in small villages across South Africa that do not have electricity by using a payment plan [37]. An online, peer-to-peer crowdfunding platform shares the project with investors who can purchase the desired amount of solar cells in the project [20] [37]. This covers the installation cost; the array is installed in less than two months [37]. The community receives electricity, paying only a small usage fee, split between Sun Exchange and the investors [37]. This platform brings affordable electricity to communities worldwide [37].

KEY LEARNINGS: Digital finance, including innovative mechanisms such as Crowdfunding, blockchain, and cloud computing, can help developing countries and low-income local communities raise funding for necessary projects.

The Sun Exchange's initiative of funding microgrids in small villages across South Africa through micro-investments provides several key learnings for local governments looking to address similar challenges:

- **Leveraging Crowdfunding for Infrastructure Development:** The use of an online peer-to-peer crowdfunding platform demonstrates an innovative way to finance essential infrastructure like micro-grids. This approach can mobilize resources from a broad base of investors, making project financing more accessible and diverse. Using digital finance to support community-based initiatives showcases the potential of technology in enhancing access to financial resources for development projects.
- **Empowering Communities with Renewable Energy:** By focusing on solar energy, the initiative addresses the issue of energy access and promotes renewable and sustainable energy sources. This approach is particularly relevant for regions facing energy shortages and rapid population growth.
- **Creating Win-Win Scenarios for Investors and Beneficiaries:** The model benefits the investors, who receive a return on their investment, the company, which gets a small usage fee, and the local communities, which gain access to affordable electricity. This mutual benefit can drive more sustainable and long-term investment in community projects. The scalability of this model means it can be replicated in various locations, adapting to local needs and contexts.
- **Rapid Implementation of Projects:** The ability to set up solar arrays in less than two months illustrates the efficiency of the approach. Quick implementation is crucial in areas where the need for electricity is urgent.
- **Promoting Energy Independence:** By setting up independent microgrids, communities can become self-sufficient in their energy needs, reducing reliance on national grids and mitigating energy supply and distribution issues. The model also encourages community participation and ownership of the energy solutions, leading to better maintenance and sustainability of the projects.

² <https://thesunexchange.com/how-it-works>



Recommendations for Policy and Action

Establish Digital Transformation Task Forces

Create dedicated task forces within local governments focused on digital transformation. These groups should include members from various departments and tech experts to ensure a holistic approach to digitalization and the maintenance of the task force throughout election cycles.

EXAMPLE | Bratislava, Slovakia

Bratislava, the capital city of Slovakia, has created a specific multidisciplinary innovation team to foster and facilitate digitalization and innovation just three years ago. The team is part of the Department of Digitalisation and serves as a service design and digital transformation unit delivering process and technological change for Bratislava services through its own open source portal Bratislava ID. The team's role is to co-design, implement, and evaluate digital services and innovative projects that address the needs of residents and city's challenges and opportunities, such as mobility, environment, social inclusion, and governance. The team also collaborates with various stakeholders, such as citizens, businesses, academia, and civil society, to co-create and co-implement these solutions. The benefits of having a specific innovation team in Bratislava are manifold. The team helps the city to:

- Use service design to identify key challenges in the quality and efficiency of public services and infrastructure, propose new processes and technologies to increase citizen satisfaction and trust.
- Enhance the city's attractiveness and competitiveness and foster economic and social development.
- Address the city's challenges and opportunities and achieve the city's vision and goals.
- Promote the city's innovation culture and capacity and encourage stakeholder participation and collaboration.
- Align the city's actions and policies with the European and global agendas, such as the European Green Deal and the Sustainable Development Goals.

Implement Digital Literacy Programs

Implementing comprehensive digital literacy programs is crucial in ensuring that government employees and citizens are equipped with the skills to effectively use and benefit from digital technologies. These programs should encompass various topics, from basic computer skills to more advanced training on digital tools and platforms relevant to different sectors. This education is essential for government employees to enhance service delivery and operational efficiency in an increasingly digital work environment. For citizens, these programs can facilitate better access to digital services and improve their ability to participate in the digital economy. Additionally, it's important to address the needs of employees who the transition to digitalization may impact. Creating targeted transition programs that offer retraining and upskilling opportunities can help these individuals adapt to new roles and technologies, ensuring that the workforce remains competent and competitive in the digital age.

Develop Digital Inclusion Policies

Formulating policies for digital inclusion is essential in bridging the digital divide, especially for marginalized and underrepresented communities. This involves implementing initiatives like subsidized internet access and establishing public Wi-Fi networks to ensure affordable and reliable internet connectivity. Additionally, setting up accessible digital service centers in these communities can be crucial. These centers provide access to digital resources and offer training and support, helping individuals

develop digital skills and literacy. Furthermore, policies should address the availability of affordable devices and technical support, ensuring that everyone can participate in the digital world regardless of their economic background.

Incentivize Small and Medium Enterprises Digital Adoption

Offering incentives like tax breaks or grants to local businesses for adopting digital technologies is a strategic approach to modernizing the local economy. This policy can significantly accelerate the digital transformation of small and medium-sized enterprises (SMEs), making them more locally and regionally competitive. By reducing the financial burden of investing in new technologies, these incentives make it feasible for businesses to integrate advanced digital tools such as cloud computing, e-commerce platforms, and data analytics into their operations. This enhances their efficiency and productivity, enabling them to tap into new market opportunities and adapt to changing consumer demands. Furthermore, fostering a digitally savvy business environment encourages innovation and attracts new investments, contributing to the region's overall economic growth and resilience.

Assist with Digitalization Financing

Broaden the scope of financial aid to include various grants, low-interest loans, and targeted project funding. This approach aims to provide comprehensive financial support to businesses and communities, facilitating their transition to digital infrastructure. The policy should also include customized financial packages tailored to the unique digital needs of different sectors, ensuring a more equitable and effective digitalization process across various communities and industries.

Upgrade Public Services with Digital Technologies

Prioritize the digitalization of key public services such as healthcare, education, and transportation. Implement e-government portals for efficient public service delivery and citizen engagement. Transition to digital platforms for municipal services to enhance efficiency, reduce corruption, and streamline service delivery, thus improving overall accessibility and user experience.

Invest in Secure Digital Infrastructure

Allocating specific funding for building and maintaining secure digital infrastructure is critical in today's increasingly digital world. This investment should encompass the physical aspects of infrastructure, such as servers and networks, and robust cybersecurity measures to safeguard sensitive data and systems against threats. By prioritizing security in the digital realm, this policy ensures the protection of essential services and the privacy of individuals and businesses. Effective cybersecurity strategies might include deploying advanced encryption technologies, regular security audits, and implementing intrusion detection systems. Additionally, part of this funding should be directed towards training and developing skilled cybersecurity personnel and raising awareness among users about best practices in digital security.

Establish Public-Private Innovation Hubs

Establishing Public-Private Innovation Hubs, in collaboration with the private sector and academic institutions, can significantly boost the development and testing of new digital technologies. These hubs would act as incubators for innovation, providing a space where businesses, researchers, and entrepreneurs can collaborate on cutting-edge projects. By facilitating pilot projects, these hubs allow for real-world testing and refinement of digital solutions before they are scaled up for wider implementation. This collaborative environment accelerates technological advancements and fosters a culture of innovation and knowledge sharing. Additionally, these innovation hubs can provide resources such as funding, mentorship, and access to advanced technological infrastructure, crucial for startups and researchers.

Foster Local Tech Ecosystems

Fostering local tech ecosystems involves supporting tech startups with funding, mentorship programs, and government collaboration opportunities. Financial support is crucial for startups, especially in their early stages. Mentorship programs link them with experienced industry experts, providing essential business insights. Facilitating their involvement in government projects gives them a platform to apply their innovations. Encouraging these startups to cluster around specific challenges fosters a collaborative environment, leading to shared resources and innovative solutions.

EXAMPLE | Falkenberg, Sweden

Falkenberg, a visionary municipality in Sweden, is rapidly emerging as a hub for sustainable food technology, aspiring to be the “Silicon Valley of Foodtech” in the Nordics. The region, home to several large-scale food manufacturers, has initiated a series of innovative steps to foster a sustainable nutrition innovation cluster:

- **Initiation of LIFE RE:FOOD Project:** Supported by the European Commission’s LIFE Programme, this project aims to develop circular mycoprotein from food industry side streams. Mycoprotein, derived from fungi, offers a sustainable alternative to meat and plant-based proteins. The project involves a consortium of partners, including Mycorena AB, a pioneering startup in mycoprotein technology, Berte Qvarn, a key food manufacturer providing the side streams, and other supporting food industry groups like Polarbröd, Atria, and ICA.
- **Support for Mycorena AB’s Industrial Plant:** Falkenberg municipality has facilitated Mycorena AB in establishing its first small-scale industrial production plant within the region. The municipality provided essential support in terms of land, infrastructure, and business development services. This plant is set to produce mycoprotein using Berte Qvarn’s side streams, supplying it to various food manufacturers for use in their products.
- **Creation of a Foodtech Innovation Platform:** The municipality has also been instrumental in creating a dynamic platform for attracting and connecting startups and innovators in the foodtech space. They have fostered a vibrant ecosystem of innovation through organizing events, workshops, and networking opportunities. Collaboration extends to various sectors, including academia, civil society, and the public sector, all contributing to a sustainable and innovative food industry.

Falkenberg’s strategic steps have established a thriving cluster of sustainable nutrition innovation, yielding environmental, economic, and societal benefits. This initiative significantly reduces greenhouse gas emissions and waste while simultaneously creating new economic value and employment opportunities. It also enhances food quality and security. Falkenberg’s efforts exemplify the influential role that cities and regions can play in addressing global challenges like the climate crisis and achieving the Sustainable Development Goals.

Support Sustainable Digital Technologies

As detailed in the section titled Roadmap to the Sustainable Implementation of Digital Technologies, this recommendation entails a process to consider the environmental impact of digital tools before implementation and prioritize using sustainable, energy-efficient digital technologies in governments, businesses, and communities. Acknowledge and support synergies between technological systems to enhance efficiency and ensure future interoperability.

Integrate Digital Tools in Environmental Management

To further enhance the integration of digital tools in environmental management, advanced data analysis and machine learning techniques can be leveraged. By utilizing machine learning algorithms

to analyze the vast amounts of data collected from sensors and IoT devices, cities can identify patterns and predict environmental changes, enabling more precise and proactive management strategies.

Set Up Digital Emergency Response Systems

To enhance emergency response management, developing digital platforms that utilize technologies like mobile apps and social media is crucial. These platforms can facilitate real-time communication during crises, providing timely updates and guidance to the public. Authorities can ensure more effective and targeted response strategies by tailoring these digital tools to address specific types of natural disasters prevalent in a city or region, such as floods, earthquakes, or hurricanes. Additionally, integrating these platforms with local emergency services and disaster management systems can streamline coordination and resource allocation.

Promote Renewable Energy through Digitalization

Promoting renewable energy through digitalization involves using digital technologies to enhance the efficiency of renewable energy systems and grid management. Energy providers can optimize the generation, distribution, and consumption of renewable energy by employing advanced analytics, artificial intelligence, and IoT technologies. This approach also includes implementing smart meters in homes and businesses, empowering consumers with real-time energy usage data. Consumers can make more informed decisions, adjust their consumption patterns, and contribute to energy conservation. Integrating digital tools into the energy infrastructure supports the transition towards more sustainable and resilient energy systems, facilitates balancing supply and demand, and enhances the capability to integrate a higher proportion of renewable energy sources into the grid.

Digitalization Across Sectors

Supporting digitalization across sectors like government, academia, business, and civil society enhances efficiency and innovation. Integrating digital tools across these areas improves data management and decision-making. Crucial to this approach is fostering inter-sector collaboration and communication, unlocking synergies for more effective solutions. For example, shared digital platforms can enable knowledge transfer between academia and businesses or improve public services through enhanced citizen engagement. This collaborative digital transformation ensures inclusivity and leverages the unique strengths of each sector, leading to more comprehensive and cohesive societal solutions.

Implement Data-Driven Urban Planning

Utilizing data analytics and artificial intelligence (AI) in urban planning transforms how cities approach sustainable development. This method allows planners to make evidence-based decisions by analyzing extensive data on various aspects such as traffic flows, population dynamics, environmental impacts, and resource distribution. Such deep insights can inform infrastructure planning, optimizing resource allocation, and accurately forecasting urban growth. AI technologies can simulate potential urban development scenarios, providing valuable foresight into the consequences of different planning strategies. This data-driven approach ensures that urban development is sustainable and adaptive to the evolving needs of urban populations and the environment.

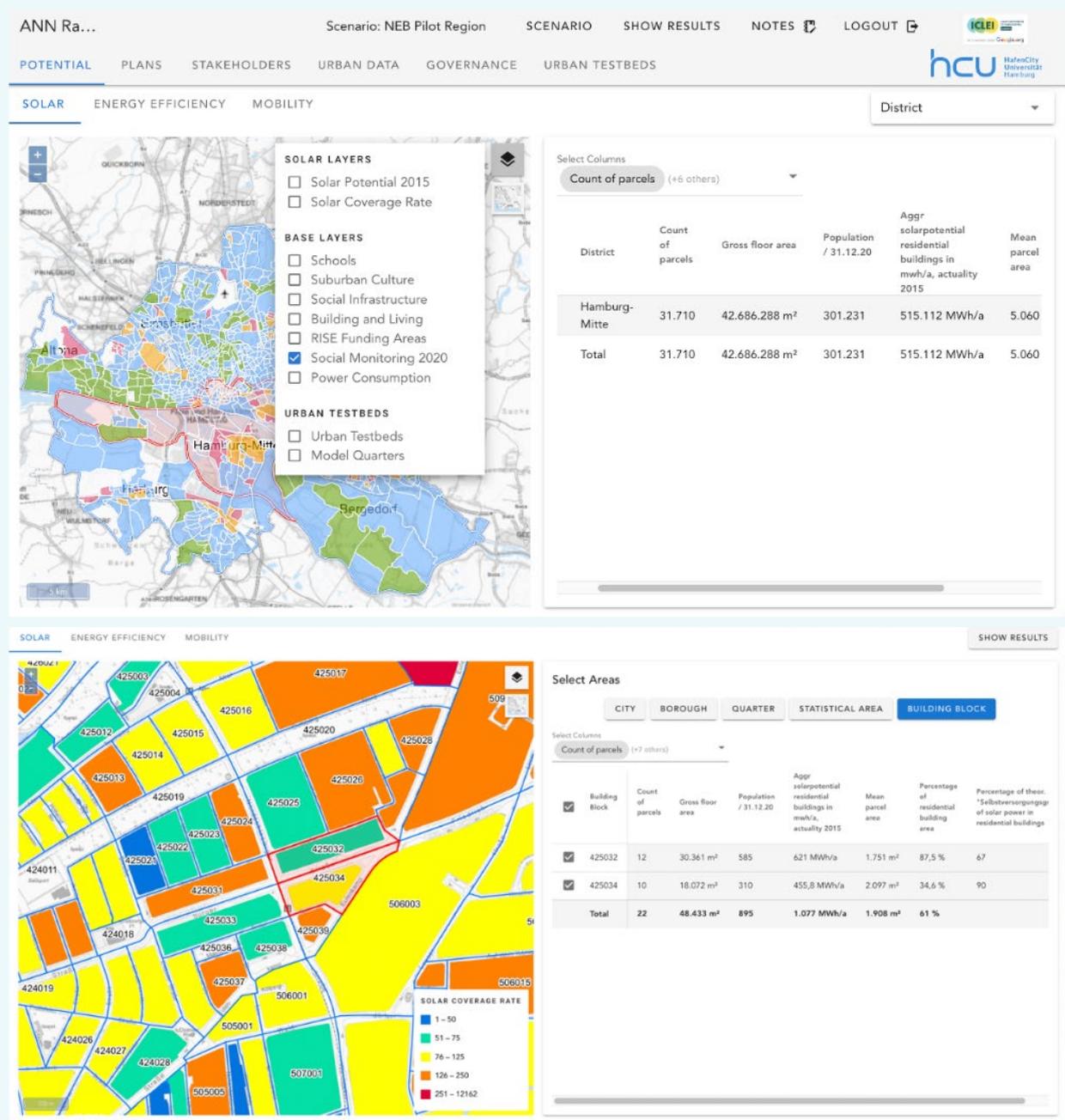
EXAMPLE | ANN RADAR, HafenCity University

Developed within the ICLEI Action Fund with the support of google.org, the HafenCity University of Hamburg developed a data-driven decision support tool to foster sustainability and climate actions in the city. The tool, called ANN (A New Normal) RADAR, aims to identify spaces and districts in the City that can be used as urban testbeds for prototyping sustainable energy innovations. This identification will be made through an interactive decision support tool based on public and private environmental data.

ANN RADAR is designed as an innovation process (experimental governance) as a service, accumulating indicators for the choices of best-suited city areas, considering local climate strategies, and the available environmental data for the longer-term monitoring of environmental impact. The tool was inspired by A New Normal in Melbourne, Australia, which prototypes and pilots in the context of a sustainable Melbourne 2030.

The [ANN Radar Playbook](#) provides a contextual introduction and a guided tour of the tool. The document includes user cases for external use in decision-making processes and technical and scientific references for transfer, adaptation, and scalability purposes, making the methodology, principles, and exemplary data dimensions transparent to professional stakeholders involved in these processes. Municipalities, climate planning and engagement consultancies, and academic institutions initiating and managing urban experimentation are at the core of the focus. The Hamburg cases can easily be adapted in other local municipalities with similar stakeholder scenarios.

Below is a representation of some of what the ANN RADAR tool features:



The screenshot displays the ANN RADAR web application interface. At the top, there are navigation tabs: POTENTIAL, PLANS, STAKEHOLDERS, URBAN DATA, GOVERNANCE, and URBAN TESTBEDS. The current view is 'SOLAR' under 'ENERGY EFFICIENCY'. A 'District' dropdown menu is set to 'Hamburg-Mitte'.

On the left, a map shows the Hamburg-Mitte district with various layers overlaid. A legend titled 'SOLAR LAYERS' includes 'Solar Potential 2015' and 'Solar Coverage Rate'. 'BASE LAYERS' includes 'Schools', 'Suburban Culture', 'Social Infrastructure', 'Building and Living', 'RISE Funding Areas', 'Social Monitoring 2020' (checked), and 'Power Consumption'. 'URBAN TESTBEDS' includes 'Urban Testbeds' and 'Model Quarters'.

On the right, a table titled 'Select Columns' shows data for the Hamburg-Mitte district. The table has the following columns: District, Count of parcels, Gross floor area, Population / 31.12.20, Aggr solar potential residential buildings in mWh/a, actuality 2015, and Mean parcel area.

District	Count of parcels	Gross floor area	Population / 31.12.20	Aggr solar potential residential buildings in mWh/a, actuality 2015	Mean parcel area
Hamburg-Mitte	31.710	42.686.288 m ²	301.231	515.112 MWh/a	5.060
Total	31.710	42.686.288 m ²	301.231	515.112 MWh/a	5.060

Below the map, there is a 'SHOW RESULTS' button. The interface then shows a detailed view of a specific area, with a 'Select Areas' dropdown set to 'BUILDING BLOCK'. A table titled 'Select Columns' shows data for selected building blocks. The table has the following columns: Building Block, Count of parcels, Gross floor area, Population / 31.12.20, Aggr solar potential residential buildings in mWh/a, actuality 2015, Mean parcel area, Percentage of residential building area, and Percentage of these "Selbstversorgungsgr" of solar power in residential buildings area.

Building Block	Count of parcels	Gross floor area	Population / 31.12.20	Aggr solar potential residential buildings in mWh/a, actuality 2015	Mean parcel area	Percentage of residential building area	Percentage of these "Selbstversorgungsgr" of solar power in residential buildings area
425032	12	30.361 m ²	585	621 MWh/a	1.751 m ²	87,5 %	67
425034	10	18.072 m ²	310	455,8 MWh/a	2.097 m ²	34,6 %	90
Total	22	48.433 m ²	895	1.077 MWh/a	1.908 m ²	61 %	

At the bottom right, there is a 'SOLAR COVERAGE RATE' legend with a color scale from 1-50 (blue) to 251-12162 (red).

Further information can be found at: <https://iclei-europe.org/funding-opportunities/action-fund/hafency/> and via GitHub at: <https://github.com/ANN-RADAR/ann-radar-prototype>

By adopting these specific policy recommendations, local governments can effectively leverage digitalization to enhance their capacities, improve public services, and lead communities toward a sustainable and inclusive digital future.

Conclusion

Though digitalization can be challenging, its myriad benefits make it a worthy investment. Digitalization can enhance government efficiency, increase economic growth, and advance sustainability. To embrace digitalization, local governments must adopt a strategic and holistic approach that considers the following aspects:

- **Vision and leadership:** Local governments must set clear and ambitious goals and targets for digitalization and mobilize and align the interests and actions of different actors and sectors. They must also provide strong and consistent political support and guidance for digitalization initiatives.
- **Policy and regulatory frameworks:** Local governments must create enabling environments and incentives for digitalization and address the barriers and challenges local actors and sectors face. They also need to ensure digitalization's legal and ethical aspects, such as data protection, environmental impact, privacy, and security.
- **Infrastructure and technology:** Local governments need to invest in and upgrade the physical and organizational infrastructure and technology that support digitalization, such as broadband, cloud, and platforms, ensuring equitable access. They must also ensure the interoperability, compatibility, and resilience of different systems and devices.
- **Skills and capacities:** Local governments need to develop and enhance the skills and capacities of local actors and sectors to use and benefit from digitalization, such as digital literacy, innovation, and entrepreneurship. They must also provide training and education opportunities for local citizens and employees.
- **Collaboration and participation:** Local governments need to develop and enhance the skills and capacities of local actors and sectors to use and benefit from digitalization, such as digital literacy, data-driven analysis, innovation, and entrepreneurship. They also need to engage and involve local citizens and stakeholders in designing and implementing digitalization initiatives.

Digitalization is a great leap forward that could revolutionize our way of life: improving governance, economic development, and sustainability. With great potential comes great responsibility; digitalization is a journey that requires strategic planning, stakeholder engagement, and a commitment to continuous innovation and improvement. Implementing these policy recommendations would be the first step toward achieving the full potential of digitalization.

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Main authors

Pourya Salehi
 David Corbett
 Rae Dunbar
 Saman Sadeh
 Alis-Daniela Torres
 Amy Jones
 Himanshu Shekhar
 Jilan Plecha
 Polina Koroleva
 Pietro Visetti
 Aboubakr Benazzouz
 Hrishi Ballal
 Johannes Ashenafi
 Aparajita Dubey
 Shailendra Kumar Mandal
 Carlos Cadena
 Lisa Indah
 Christian Barthelt
 Erick Tambo
 Simone Sandholz
 Asad Asadzadeh
 Petra Dzurovčinova
 Josef Noll

Design

Olga Tokareva

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Contact Us

Kaiser-Friedrich-Str. 7
 53113 Bonn | Germany
 Tel. +49-228 / 97 62 99-00